Weekly Report -14-12-23(Sindhuja Chaduvula)

An overview of the OpenStreetMap Web Wizard for SUMO

Introduction

Traffic simulation plays a crucial role in urban planning, traffic management, and the development of intelligent transport systems. SUMO(Simulation of Urban Mobility) is an acclaimed open-source traffic simulation software designed to handle large road networks and diverse traffic scenarios. An integral feature of SUMO is the OpenStreetMap(OSM) Web Wizard, which simplifies the process of creating realistic traffic simulations based on real-world data.

The OpenStreetMap Web Wizard: Bridging Real-World Data and Simulation

The OSM Web Wizard is a tool within the SUMO suite that allows users to automatically generate traffic simulations from geographical data obtained from OpenStreetMap, a collaborative project to create a free editable map of the world. This tool is instrumental in translating detailed geographic data into dynamic models for traffic simulation.

Key features of the OSM Web Wizard

1. Automatic Network Generation
2. Traffic Demand and Flow Generation
3. Graphical User Interface
4. Customization Options
5. Ease of use

Applications and Impact

The OSM Web Wizard has significant applications in urban and transport planning, traffic engineering, and educational contexts. It enables users to model and analyze traffic scenarios reflective of real-world conditions, providing valuable insights for traffic management strategies, infrastructure development, and research initiatives.

Conclusion

The OSM Web Wizard stands out as a pivotal tool in the realm of traffic simulation, using the detailed geographic data of OpenStreetMap with the robust simulation capabilities of SUMO. As urban spaces evolve and transportation becomes increasingly complex, tools like the OSM Web Wizard will play a vital role in shaping efficient, sustainable and intelligent mobility solutions.

Converting Traffic Simulation Data: From SUMO to Lanelet2 via OpenDrive and CommonRoad

In traffic simulation and autonomous vehicle research, efficient conversion of traffic data across multiple formats is essential. This report outlines a multi-stage process starting with SUMO's OSM Web Wizard and transitioning through OpenDrive, CommonRoad, to lanelet2 each vital for detailed road network representation and supporting advanced vehicular technologies. These Formats collectively enhance the accuracy and applicability of traffic simulations in modern transport systems.

Conversion to OpenDrive Format

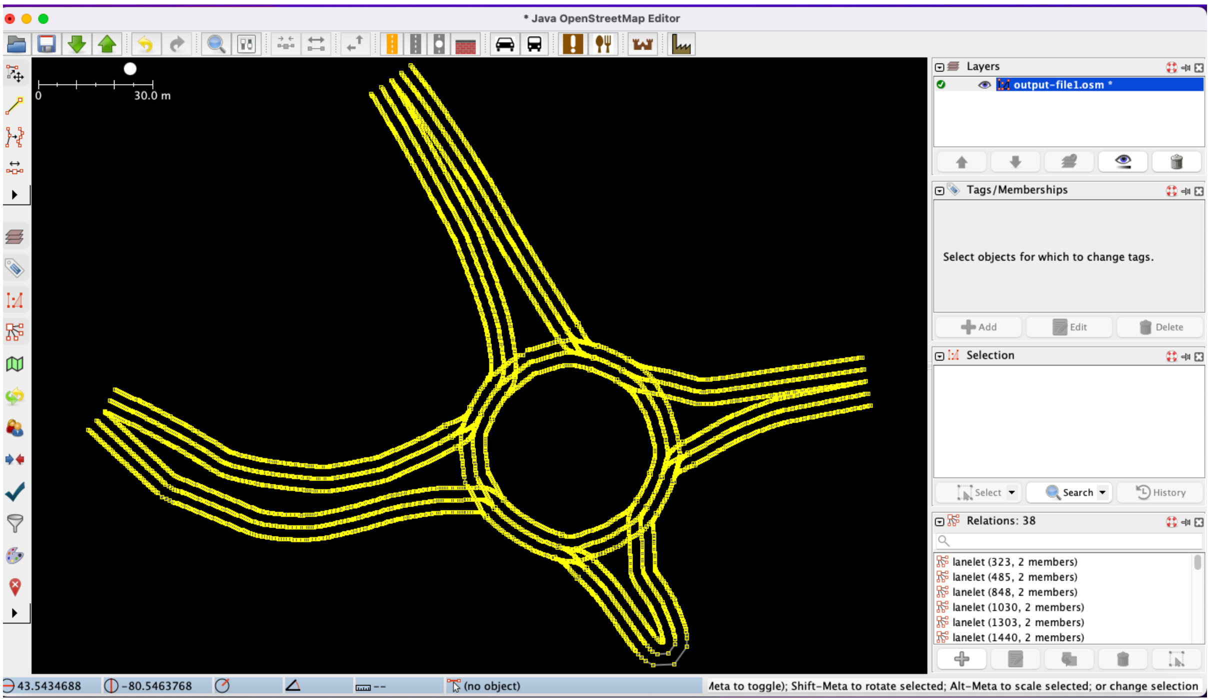
After the SUMO simulation, the data is converted to OpenDrive using 'netconvert' a tool that excels in translating detailed road network. This step is pivotal to ensure compatibility with diverse traffic simulation and analysis tools. OpenDRIVE is particularly valued for its intricate rendering of complex road elements, crucial for simulations in the realm of autonomous driving.

Transition to CommonRoad Format

Post OpenDRIVE conversion, the data is transitioned to CommonRoad format using **crdesigner map-convert-opendrive**, catering specifically to autonomous driving's motion planning and trajectory optimization. This format comprehensively captures both static and dynamic traffic elements, essential for rigorous algorithmic validation and the development of advanced vehicle control systems.

Final Conversion to Lanelet2

In the final stage, data is converted to the Lanelet2 format using **crdesigner map-convert-lanelet**, providing high-definition lane-level mapping crucial for ADAS and autonomous driving. Lanelet2's precision in detailing lane information, road attributes, and traffic rules enhances the safety and efficiency of autonomous vehicles. This format is thus ideal for comprehensive traffic analysis and route planning in autonomous driving systems.



Conversion of X, Y coordinates in fcdoutput to latitude and longitude

In the field of traffic simulation, the integration of Floating Car Data (FCD) with geographic coordinates in SUMO (Simulation of Urban Mobility) represents a significant advancement. By configuring SUMO to output vehicle positions as longitude and latitude, the simulations gain enhanced realism and practicality, closely mirroring real-world traffic scenarios. This approach not only facilitates more accurate traffic analyses but also allows for seamless overlay of simulation data onto actual geographic maps, enhancing visualization and contextual understanding.

Representing fcd output using lanelet2 file

Step 1 – Iterating through each of the element depending on whether the element is ‘node’, ‘way’ or ‘relation’.
Step 2 – Processes individual ‘node’ element and extracts the ID, latitude and longitude of each node and stores them in ‘nodes’ dictionary.

Step 3 - Retrieves the way's ID and the references to the nodes that compose the way. It stores this information in the ‘ways’ dictionary and updates the ‘node_to_way’ mapping to link each node to its corresponding way. The function prints node references, which can be useful for debugging or analysis.
Step 4 - Extracts the relation's ID and processes its member elements. If a member is a 'way', it updates the ‘way_to_relation’ dictionary, mapping way IDs to the relation ID. This is key for understanding how different ways are grouped together in more complex structures or lanelets.
Step 5 - Calculates the Euclidean distance between the FCD point and each node in the OSM data, returning the ID of the closest node within a specified tolerance.
Step 6 - Reads the original FCD file and for each vehicle, removes certain attributes and uses find_closest_node to associate the vehicle with the nearest OSM node, way, and lanelet. It then writes these modifications to a new XML file.

The script effectively bridges data from SUMO's Floating Car Data (FCD) with OpenStreetMap (OSM), providing enriched context for traffic simulations. By mapping FCD points (representing vehicle positions) to specific nodes and ways from OSM, it enhances FCD's utility in detailed traffic studies. The parse_xml function initializes this process by parsing the OSM file and directing elements to their respective processing functions. process_node, process_way, and process_relation build comprehensive mappings of nodes, ways, and relations, crucial for understanding the geographic context of traffic data.

The critical find_closest_node function then ties each vehicle data point from FCD to the nearest OSM node, based on geographic proximity. Finally, modify_fcd_xml enriches the FCD file with this new information, creating a more informative dataset that combines the dynamic nature of traffic flow with the static geographical layout of road networks. This enriched data is invaluable for advanced traffic analysis, urban planning, and potentially for autonomous vehicle navigation systems, offering a more nuanced and accurate understanding of traffic patterns.